Towards Terabit/s (Tbps) Visible Light Communication – LiFi

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Abstract: We will review technologies that will lead to Tbps multiuser indoor wireless access systems for 6G using ultraviolet, visible and infrared light and highlight the resulting challenges. We will consider transmitter and receiver designs and channel effects.
In order to unlock the full optical spectrum for mobile wireless networks, it is required to use wavelength division multiplexing (WDM). It then becomes a question of how narrow the emission spectrum per WDM channel can be made to scale the link data rates. For example, in some previous work we used dual wavelength SMD (surface mounted device) laserlight devices to achieve 26 Gbps [1] (on average 13 Gbps per wavelength), and showed that with 10 different wavelengths, it is possible to achieve 100 Gbps. Consequently, with 100 SMD lighting devices, the projected data rate is 1 Tbps. The receiver has to be capable of separating the different WDM and possible solutions are proposed.
The advantage of WDM in a wireless networking application is that different WDM bands can be assigned to different users located at different positions in a room. This then leads to wavelength division mulitple access (WDMA). These positions may change due to user mobility. One of the challenges in such scenario is that the angle of arrival (AoA) of the lightwaves are random leading to a random passband shifts [2] which cause multiuser interference. There is, therefore, a fundamental trade-off between capacity and number of users served in WDMA. However, it is possible to mitigate multiuser interference by dynamically changing the WDMA channels depending on the new user locations. Consequently, we proposed adaptive WDMA [3]. Assuming that a LiFi network is composed of multiple access points, the optimum mapping between WDMA channels and mobile devices at any given time becomes a non-trivial problem because these networks additionally suffer from co-channel interference especially at the boundaries of the access point coverage area. Artificial intelligence (AI) / machine learning (ML) techniques may be used to advance adaptive WDMA systems.
This talk will discuss adaptive WDMA LiFi networks starting from transmitter and receiver system designs and moving on to the design of adptive WDMA algorithms. We will end the presentation by stating open issues and future work.

References

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